Congestion Control by Load Balancing within the Data Network via Modified Depth-Breadth routing Algorithm

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***Abstract*—This Paper presents the method for controlling the congestion by modifying DB routing algorithm is presented. MDB (Modified Depth wise, breadth wise) routing algorithm an implementation of AntNet is an agent based routing algorithm that is influenced from individual behavior of the ants in ant colony optimization. Ant Net. algorithm does not take into account of the effect of increasing the total numbers of routing packets (ants) moving inside the network which may lead to congestion problem. This could eventually have a negative impact on the overall network performance. Moreover, AntNet concentrates only on the problem of routing not load balancing as AntNet philosophy can lead to network congestion and create bottlenecks. The main objective of this work is modifying the DBrouting algorithm to address its above mentioned drawbacks. This work measures the effect of increasing the number of ants on the average packet delay and network throughput; and modifying, accordingly, the ants' generation rate. Also we introduced a modified MDB routing load- aware algorithm that improves DB routing in order to support load balancing.**

***Index Terms*— Node balancing, Ant Colony Optimization, Positivefeedback, Negative feedback, routing,metaheuristics, Mobile Agents, Performance, Routing**

I. Introduction

This paper projects the problem of routing in communication networks, in particular, wide area datagram networks, the most remarkable example being the internet. Routing algorithm is the key element in networks performance, and thus it can be seen as the brain of the network. The routing algorithms currently in use are not adequate to tackle the increasing complexity of such networks [1], [2]. In recent years, a new class of mobile agent-based algorithms, inspired by swarm intelligence, has been widely applied to routing in communications networks. Swarm intelligence routing provides a promising alternative to traditional routing algorithms by utilizing mobile software agents for network management. These agents are autonomous entities, both proactive and reactive, and have the capability to adapt, cooperate and move intelligently from one location to the other in the communication network [3], [4]. Ants Can explore vast areas without global view of the ground. They can find the food and bring it back to the nest by converging to the shortest path. How can they manage such great tasks? By leaving pheromones behind them. Wherever they go, they let pheromones behind here, marking the area as explored and communicating to the other ants that the way is known.A number of swarm-based routing algorithms are proposed [4]- [6]. The most celebrated one is the AntNet which is originally proposed by Dorigo and Di Caro [6]-[9]. AntNet has shown very promising results and has out performed best known routing algorithms. This work focuses on AntNet algorithm. Two modifications are suggested to be added to AntNet algorithm in order to improve its performance in term of throughput and average packet delay through Introducing a modified DB routing load-aware algorithm that improves DB routing in order to support load balancing.

Intelligent behavior from colonies of artificial ants [Bonabeau et al., 1999]. DB routing algorithm focuses only on the method of traversal.in deapth wise breadth wise routing algorithm (MDB) routing in this paper we present a modified version of DB routing algorithm with node balancing concept.

II. DB ROUTING OVERVIEW

The DB routing algorithm projects more on the searching method used to find out the shorter path to send the data packets. It starts with drawbacks of both the Depth first search (DFS) and Breadth first search (BFS)methods and introduces the new searching method with the positives of DFS and BFS methods.

DB routing provides a path to an incoming packet much faster than existing routing algorithms. This basically an Artifical Intelligence (AI) Concept, used to get from the source to the destination. A routing algorithm Depth wise, Breath wise (DB) Routing is based on a general-purpose metaheuristic named Ant Colony Optimization, is a framework for building ant-inspired algorithms. DB is applied as the routing algorithm in a simulated packet-switched point-to-point network. It is to check whether DB can obtain an increase in throughput when packets are sent between two distinct nodes and to investigate on how prioritizing different heuristics effect the quality of the routing performed. It is concluded that DB behaves differently depending on the relative priority of either positive or negative feedback and local heuristics; also it is

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possible to adjust the parameters to achieve best results by improving routing time.

Individual ants are simple insects, but collectively they are capable of performing a number of varieties of complicated and tough tasks. DB is an agent based routing algorithm that is influenced from the real ants' behavior. In real life, ants deposit a chemical substance to mark the path they have traversed. Then on their way back they choose the path with the most pheromones which becomes the shortest path. In DB a group of mobile agents (or artificial ants) build paths between pair of nodes, exploring the network concurrently and exchanging obtained information to update the routing tables. This information is also used to direct the data packets towards their destination [8], [9].

III.MODIFICATIONS PROPOSED TO DB ROUTING ALGORITHM

Original DB routing algorithm focuses only on the searching method used in finding out the shorter paths in the network but not on node balancing concept.

Based on the original DB routing algorithm few modifications are suggested to be added to enhance its performance.

A. Congessition Control(Control of the Number of Ants in the Network)

For every algorithm, the network load generated by routing packets is stored as the ratio between the bandwidth occupied by all the routing packets and the total available network bandwidth. The routing overhead is the main function of the topological properties of the network and of the generation rate of the routing information packet. AntNet produces a routing overhead depending on the ants' generation rate and the length of the path along they travel. As the followed path of routing ant grows (either because of topology or bad routing) the routing overhead grows. The DB routing and original AntNet does not take into account the generated routing overhead and its effect on overall network performance.

B. Introducing Load Balancing Technique to over come the above mentioned problem

Original DB routing algorithm addresses the routing problems but not load balancing [11]. Load balancing is heavily relied on routing; AntNet routing philosophy can lead to network congestion, high delay and may create deadlock. For example a node that lies on several routes will have a large number of packets for different destinations in its interface queue; all these packets will experience high queuing delays resulting in a high overall end to end delay. Load balancing technique is needed to remove such bottlenecks.

The optimal solution found in the first phase is then finalized by a deterministic procedure that adjusts flows in order to achieve the precise balance of the input-output flow at each node. A outline of this procedure is shown as follows

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Input: Original flows stored
output: Modified flows that satisfy the condition in which each inner node of the network, the sum of its output flows is less than or equal to the sum of its input flows.

1.1 Assign starting flows to network edges
1.2 Initialize the list of nodes expected to be processed N=P
2 do
3 Take the first node P from the list N
4.1 Recalculate output flows of node P
4.2 Add all nodes that have been affected
by this action to list N
5 while(S 6= {})
```

Modified DB algorithm for direct representation.

For any node if its total input flow is bigger than its total output flow, it finds a path from the given node to the source node, and then decreases the flow along that path as much as possible. This might be repeated several times for each node, until the excess input flow has been completely removed.

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input: Flows that already satisfy the condition that at each inner node the sum of its output flows is at most as big as the sum of its input flows.
output: Balanced flows for which the balance condition holds is that every inner node has its total output flow equal to its total input flow.

1 while (exists node v with unbalanced in-out flows)
2 flow difference= v. in - v. out
3 do
4.1 Find an acyclic path P from v to the source node s such that all edges in the path are assigned a positive flow.
4.2 Set minimize to the flow of the edge with the minimal flow along the path P
4.3 minimize = min(minimize, flow diff)
5 Decrease flows of all edges of path P by value of minimize
6 flow diff = flow diff - minimize
7 while (flow diff > 0)
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Algorithm for finding balanced flows in every inner node of the network using

IV . EXPERIMENTS & RESULTS

Here the experiments were conducted on 5X5 grid network topology using MDB routing algorithm and DB algorithm as benchmark and compared the results.fig1 and fig2 are the routes generated respectively. The results were clearly shown in the table1 and table2 respectively.

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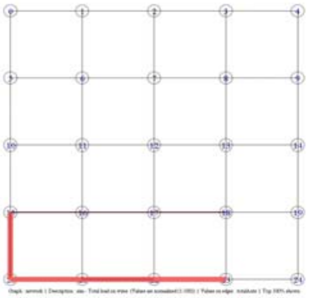

Figure1. Routes generated by MDB algorithm

Table1 Results from experiment 1

Number of packages	1000
Dead	658
TTL	0
INPUT	657
OUPUT	0
NPRDies	10
Average time for package	249.43

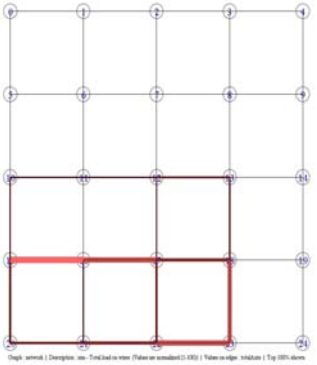

Figure2. Paths generated by DB routing algorithm

Table2. Results from experiment 2.

Number of packages	1000
Dead	667
TTL	0
INPUT	658
OUPUT	0
NPRDies	0
Average time for package	251.68

V. Comparison of MDB with DB algorithms & Conclusions

	DB Algorithm	MDB Algorithm
No. Of Packets	1000	1000
Dead	667	658
Average time for packet	251.68	249.43

Table 3 Comparative results of MDB and DB Routing algorithms

A surprising observation is that MDB routing algorithm is able to route the packages faster through the network than the DB algorithm. The reason for this is the difference in the way the traffic is distributed (see Figure 1 and Figure 2). The MDB algorithm distributes the traffic by utilizing most of the routers . This also controls

the packet death while transmitting the data packets

The performance of the routing algorithms is measured by two factors. First the average time taken for data transmission of packet and other depends on the death rate of the packet while transmitting.With the above results we conclude that MDB routing algorithms performs better than the DB routing algorithm with less average time of the packet and less dead packets.(see table 3).

With the concept of load balancing in the DB as Modified DB(MDB) one can improve the speed of data transmission, can control the death rate and finally improving the throughput

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